2016

Design and Development of a Microfluidic Platform to Induce Mechanical Stimuli on Growing Axons

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Abstract

In cases of injury and degenerative diseases, stresses can be placed on individual nerve cells in the human body that greatly, and often permanently, impact the function of the human nervous system. In order to treat these it is imperative to better understand the effects these stresses can have on the development and function of individual neurons. Because of the logistical difficulties of studying cells in-vitro, it has become increasingly popular to study neuronal cells in vivo using microfluidic devices. Current studies focus mainly on the impact of chemical signals on neurons. The focus of this study however, is to develop a versatile system for testing a variety of mechanical stimuli and its effect on axonal outgrowth and signaling in neurons. In this study a microfluidic device was designed and produced in which neurons could be cultured. The device design encourages unidirectional axon outgrowth in the cells so that once the cells are grown, stresses applied to the device itself will impact each cell in a similar manner. With the mold created, a high number of identical device can produced and cultured in parallel to study different mechanical stimuli such as tension and compressive forces placed on the axons.